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Notes on the genus Widdringtonites

EDWARD W. BERRY

(WITH PLATES 24, 25)

It is the fashion among a large proportion of botanical students either to ignore or actually to deride botanical determinations based upon the remains of the foliage of fossil plants. While this is perhaps justified in some instances by the sanguine determinations of some paleobotanists, particularly those who might with propriety be referred to as the "fathers" of this as yet young science (such men as Unger, Heer, and Ettingshausen), the real importance of their work is generally underestimated.

The careful description and illustration of a fossil flora is of immense importance even if seventy-five per cent of the identifications are wrong, and for the following reasons: For the purpose of correlating distant geological formations fossils are theoretically almost as useful unnamed as named, or at least they would be if there were some medium for intellectual exchange that did not require names.

To illustrate their value to the botanist I will take the case of A who describes the flora of the Cretaceous or Tertiary of Bohemia, misidentifying half of his species. B studies the Cretaceous or Tertiary flora of Greenland and finds a number of specimens like A's types. Several of B's specimens are better preserved, or are represented by more material, or have attached fruits or seeds, thus enabling B to correct some of A's wrong determinations. C studies the Cretaceous or Tertiary flora of America or Asia and in a like manner corrects or substantiates beyond cavil some of A's or B's determinations. Thus in time we come to know A's original flora and are enabled to make many deductions regarding phylogeny, climate, and distribution, which would be entirely impossible if A had waited until he had his species represented by flowers, fruits, and seeds, which would probably have been never.

I have assumed that foliage remains are not capable of unequivocal identification but this is far from being the case in most instances. I did not start, however, to write a plea for paleobotanists, but with the purpose of describing some rather exceptional coniferous material from the Upper Cretaceous of this country, which serves to substantiate a generic determination made years ago by that most sagacious and illustrious of paleobotanists, the late Professor Oswald Heer.

The genus *Widdringtonites* was established in 1847 by Endlicher* with *Thuites gramineus* Sternberg from the Tertiary of Perutz, Bohemia, as the type. This he named *Widdringtonites Ungeri*, including in its synonymy *Juniperites baccifera* Unger, *Thuia graminea* Brongniart, and *Muscites Stolzii* Sternberg. Three additional species were listed, one from the Cretaceous, one from the Wealden, and one from the Lias. His characterization of the genus was as follows: "Folia spiraliter inserta, pleraque squamaeformia adpressa. Strobilus globosus, valvatus."

There are perhaps a score of species, ranging in age from the Triassic to the Miocene, that are referred to this genus at the present time. It has been commonly used for foliar specimens that resembled the living forms but lacked the certainty furnished by associated cones. These are known, however, in a large number of species, many of which, especially those of Tertiary age, are now often referred directly to the genus *Widdringtonia.*

Named originally for its resemblance to the living species of *Widdringtonia* of southern Africa and Madagascar, it is to be noted that in the latest treatment of the modern Cupressineae, by Eichler in Engler and Prantl's Die Natürlichen Pflanzenfamilien (1889), *Widdringtonia* is made a subgenus of *Callitris* Ventenat, the latter being divided into four subgenera as follows: *Octoclinis* F. v. Müller (*Frenela* Bentham) with eight scales to the cone and a single species inhabiting Australia; *Hexaclinis* (*Frenela* Mirbel) with six scales to the cone, 3 large and 3 small, and nine species of Australia and New Caledonia; *Pachylepis* Brongniart (*Widdringtonia* Endlicher) with thick woody cones of four subequal scales and having three or four species of South Africa and Madagascar; *Eucallitris* Brongniart (*Tetraclinis*) with four scales to the cone and a single species of northern Africa.

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* Endlicher, Synopsis Coniferarum 271. 1847.

However admirable this arrangement may be when only the living species are considered, it will not answer for the fossil forms, and paleobotanists quite rightly maintain the various genera *Frenelites*, *Frenelopsis*, *Widdringtonia*, *Widdringtonites*, *Callitris*, etc., ranging in age from the older Mesozoic through the Tertiary and abundantly fortified by fruiting specimens. Fossil fruits of still other species and perhaps genera occur in the late Tertiary formations of Australia, the weight of the evidence showing that this type was considerably more varied in the past, the existing forms being isolated remnants of a once almost worldwide distribution.

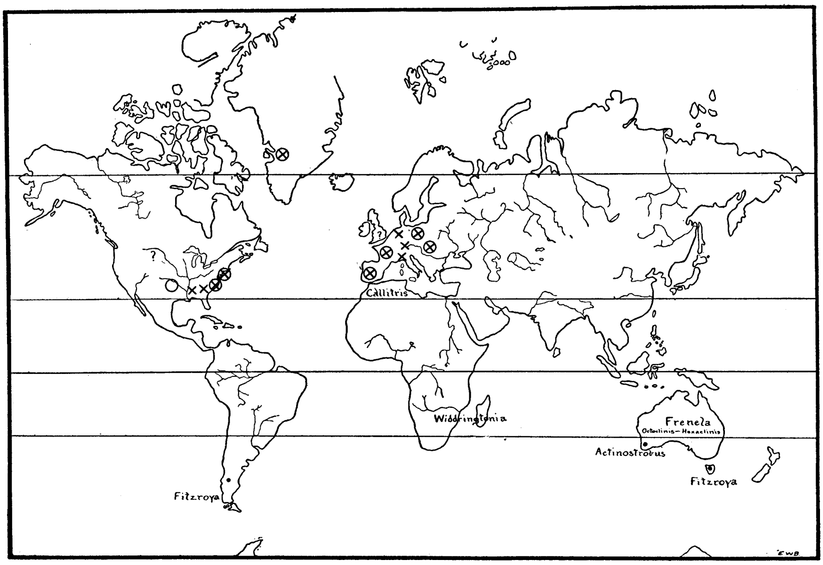

FIG. 1. Sketch map of the world showing the segregation of the existing Actinostrobinæ and the Mesozoic occurrences of *Frenelopsis* and *Widdringtonites*. Circles indicate *Frenelopsis* and crosses indicate *Widdringtonites*.

The accompanying sketch map of the world partially indicates the former wide range of these forms. It is incomplete in that it shows only the reported occurrences during the Mesozoic age and does not include the numerous Cenozoic records. It will be seen that *Widdringtonites* is recorded in North America from western Greenland southward to Alabama and *Frenelopsis* from Greenland to Texas. Abroad both types occur abundantly in central and western Europe. Like so many other types of plants which were widespread in Mesozoic time, they became more and more restricted in their range during the Tertiary, until today they are not found at all in the western hemisphere and are confined to the limited areas indicated on the accompanying sketch map (FIG. 1).

If we refer only to the Cretaceous forms of *Widdringtonites* there are four species in the Neocomian, one in the Barremian, one in the Albian, three in the Cenomanian, and one in the Senonian.

Widdringtonites subtilis was described from the Atane (Upper Cretaceous) beds of Greenland by Professor Heer* in 1874. His material was, however, extremely limited. Subsequently, similar remains were found in considerable abundance in the Raritan formation of New Jersey,† and still more recently Hollick‡ has recorded them from Marthas Vineyard and Block Island (Magothy formation). The writer has found it in the Magothy formation of Maryland § and in the Middendorf beds of South Carolina.|| It may also be questioned if some of the coniferous material described by Velenovsky from the Bohemian Upper Cretaceous under other names should not be compared with the present form.

The material from the Tuscaloosa formation of western Alabama, which furnishes the basis for the following notes, is abundant, being especially common at the locality known as the Snow Place in Tuscaloosa County; and it enables a considerable addition to be made to the knowledge of this species, which may be described as follows:

Foliage more or less dimorphic, very variable in this respect. Leaves, especially those on the young twigs, arranged in a crowded spiral, small and pointed; the inner surface comparatively flat and bounded laterally by sharp, somewhat thickened angular edges, the outer side broad, full, and rounded. The young leaves are crowded and relatively short, broad, and appressed, the short incurved pointed tips giving them the appearance of being rounded

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* Heer, Fl. Foss. Arctica 3^2: 101. *pl. 28. f. 1, b.* 1874.

† Newberry, Fl. Amboy Clays 57. *pl. 10. f. 2–4.* 1896.

‡ Hollick, Mon. U. S. Geol. Surv. **50**: 45. *pl. 4. f. 2–5.* 1907.

§ Berry, Johns Hopkins Univ. Circ. New series 7: 81. 1907.

|| Berry, Bull. Torrey Club **38**: 421. 1911.

apically (see FIG. 1 and 2). These leaves are not so short and broad as they appear in FIG. 1, 3, 4, 5, since in these specimens the entire leaf substance, except the cuticularized epidermis, has disappeared, and they are much flattened. The older leaves usually become elongated proximad and somewhat spreading and falcate distad, with a considerable decurrent base as shown in FIG. 2. The leaves on twigs of the year are about 1.5 mm. in length while those on old twigs are about 2 to 3 mm. in length. Along their lateral angles the former bear minute spines, which increase in size and length distad (FIG. 3, 3*a*). The epidermal cells are small, about 0.025 to 0.0333 mm. in diameter, the longest diameter approximately parallel with the axis of the leaf, more or less regularly rectangular in outline except at the angles of the leaf and in the vicinity of the stomata, and they have very thick yellowish walls. The stomata are about 0.0333 mm. in diameter and show two thick, generally almost closed, nearly white, blunt-ended guard cells, without fixed orientation with respect to the different pairs or the major axis of the leaf. They appear to lie just beneath the surface of the epidermis. The guard cells are surrounded by a ring of five or six accessory epidermal cells, which are smaller than the regular epidermal cells, nearly uniform in size, and with their inner walls thinner than their outer. These appear to be on the same level as the ordinary epidermal cells. The stomata are sparsely scattered over the major portion of the leaf but are usually absent or but sparingly represented in the distal half of the leaf. They are somewhat massed toward the base on the sides of the leaf.

The position of the stomata on the leaf shown in FIG. 5 is indicated in the enlarged drawing which forms FIG. 5*a*. The degree of spreading or appression of the leaves varies from specimen to specimen, due, I suppose, in some measure to the conditions attending fossilization. A form with uniformly slender and spreading leaves is common at Shirley's Mill, Fayette County, Alabama.

In his discussion of this species Professor Newberry mentions a vague cone about one cm. in diameter as included in the Raritan material from New Jersey. I have not seen this specimen, but I have found a number of poorly preserved detached cones among the abundant remains of this species in the Upper Cretaceous beds of South Carolina. A number of specimens from the Tuscaloosa formation have these cones attached to the characteristic twigs of this species (PLATE 24, FIG. 2). These cones are terminal, roughly spheroidal in outline, and apparently consist of four thick scales with wide blunt tips and somewhat extended bases. They are 7 to 9 mm. in length and 4 or 5 mm. in diameter and are closely comparable to the cones from the Cretaceous of eastern Europe ascribed to *Widdringtonites Reichii* by both Velenovsky[*] and Krasser.[†] One of the best preserved of these attached cones from Alabama is shown enlarged ten times in FIG. *2a*.

So far as I know, the only previous description of stomatal or epidermal characters in fossil species of the genus *Widdringtonites* refers to species preserved in the Baltic amber, which is of Tertiary age and some millions of years younger than the species just described. One of these species, *Widdringtonites oblongifolius* Goeppert and Menge, is extremely close to the Cretaceous species *Widdringtonites subtilis* Heer not only in its general facies but in the details of its epidermal characters. As described recently by Caspary,[‡] the chief difference is the more elongated leaf bases, a feature that is always of extreme variability in this genus, and even within the limits of a single species, as is well shown by the specimens of *Widdringtonites subtilis*, which are figured in the present connection.

Although so little has been published that refers to *Widdringtonites*, several authors have described the somewhat similar epidermal characters in the allied extinct genus *Frenelopsis*. Thus Zeiller[§] described these features for the type of the latter genus, *Frenelopsis Hoheneggeri* Schenk, in 1882, and Velenovsky[||] described the very similar *Frenelopsis bohemica* in 1888. Recently the present writer described[¶] these features in *Frenelopsis ramo-*

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[*] Velenovsky, Gym. Böhm. Kreidef. 27. *pl. 8. f. 4–6; pl. 10. f. 1, 11, 12.* 1885; Sitz. K. Böhm. Gesell. Wiss. **1886**: 639 (6). *pl. 1. f. 14–16.* 1887.

[†] Krasser, Beitr. Paläont. Ost.-Ung. u. Orients **10**: 126. *pl. 14* (4) *f. 6; pl. 17* (7). *f. 4, 7, 8.* 1896.

[‡] Caspary, R. Abh. K. Preuss. Geol. Landesanstalt. Neue Folge, Heft 4. **1906**: 66. *pl. 9. f. 52–53c* (see especially *f. 53a, b, c*).

[§] Zeiller, Ann. Sci. Nat. Bot. VI. **13**: 231. *pl. 11.* 1882; Elements de Paleobotanique 274. *fig. 196.* 1900.

[||] Velenovsky, Sitz. K. Böhm. Gesell. Wiss. **1888**: 590. *f. 1–3, 10.* 1888.

[¶] Berry, Bot. Gaz. **50**: 305–309. *f. 1, 2.* 1910.

sissima Fontaine, a Lower Cretaceous species of eastern North America.

In all of these three species the epidermal cells are small, more or less rectangular, and thick-walled, as they are in *Widdringtonites subtilis.* The stomata consist of a ring of from four to six radially arranged and more or less elevated guard cells. These cells are represented in *Widdringtonites subtilis* by the ring of accessory epidermal cells shown in FIG. 6, which occupy the same level as the rest of the epidermis, while lying below this level are the two stout guard cells.

Frenelopsis ramosissima differs from the other two species of *Frenelopsis* previously mentioned in having certain of the epidermal cells spined, and *Widdringtonites subtilis* Heer curiously resembles *Frenelopsis ramosissima* in that the epidermal cells along the lateral angles of the leaf have more or less developed small spines, which increase in length and size distad, as shown in FIG. 3*a* and 5*a*.

A consideration of the sum of the known characters in the genera *Widdringtonites* and *Frenelopsis* leads to the conclusion that they are surely related.

The combination of similar foliage, similar four-valved cones; and similar epidermal and stomatal features in *Widdringtonites* and *Widdringtonia* render certain the reference of the Upper Cretaceous species *Widdringtonites subtilis* Heer to what represented the modern subfamily Cupressineae during the Cretaceous.

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Explanation of plates 24, 25

PLATE 24

FIG. 1. From a photograph of a specimen from the Tuscaloosa formation at Big Gully, Snow Place, Tuscaloosa County, Ala., natural size.

FIG. 2. Another specimen from the same horizon and locality, showing a number of poorly preserved attached cones.

FIG. 2*a*. One of the cones from the specimen shown in FIG. 2, enlarged ten times.

PLATE 25

FIG. 1. From a photograph of a small terminal twig which was much flattened during fossilization, enlarged five times.

FIG. 2. Drawing of a twig showing the dimorphic character due to the elongation of the leaves on the older twigs, enlarged five times.

FIG. 3. Microphotograph of a leaf showing the indistinct outlines of the epidermal cells and the spinous character of the distal margins, enlarged ten times.

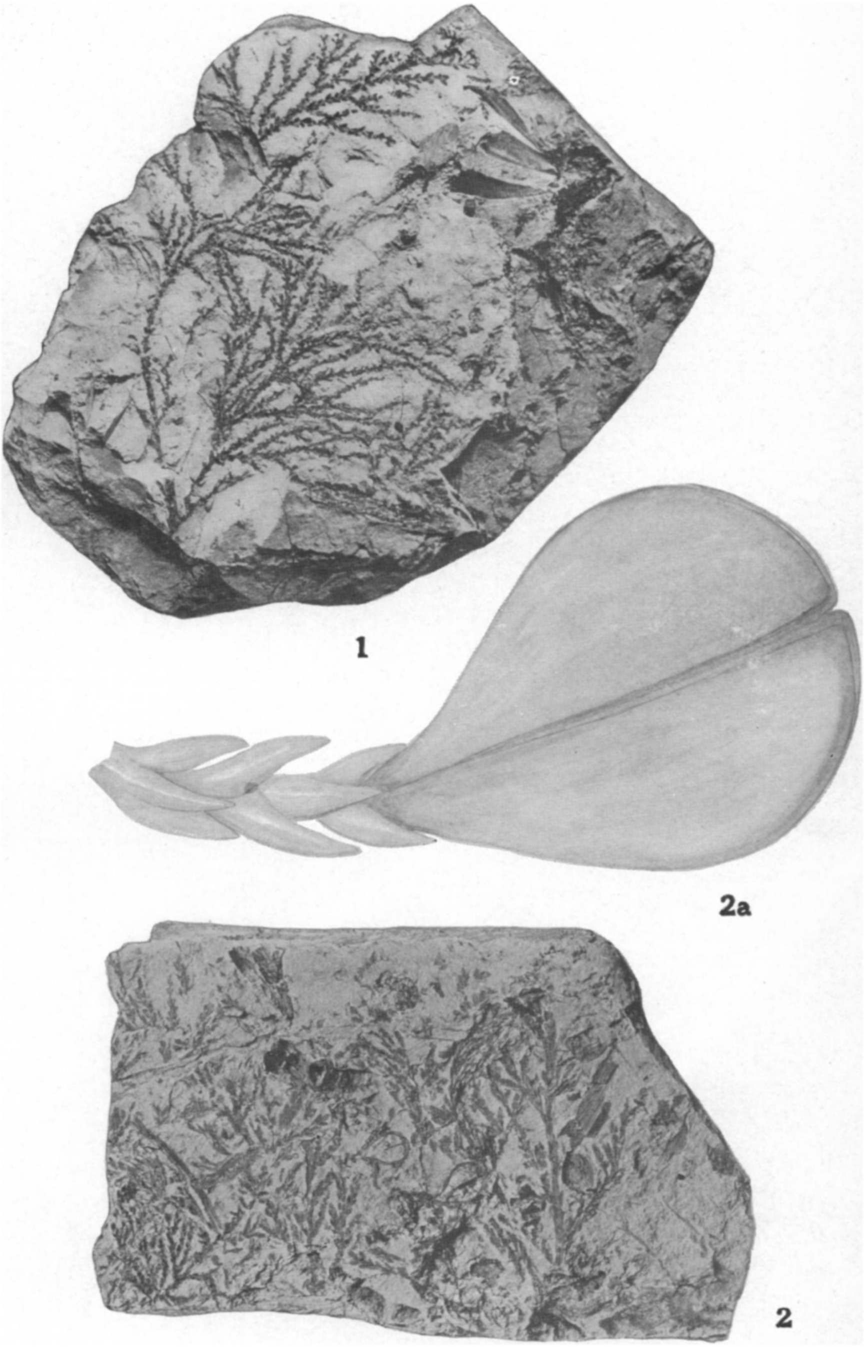
FIG. 3*a*. Drawing of the distal part of the preceding specimen showing the spines, enlarged 50 times.

FIG. 4, 5. Microphotographs of two additional leaves, enlarged ten times.

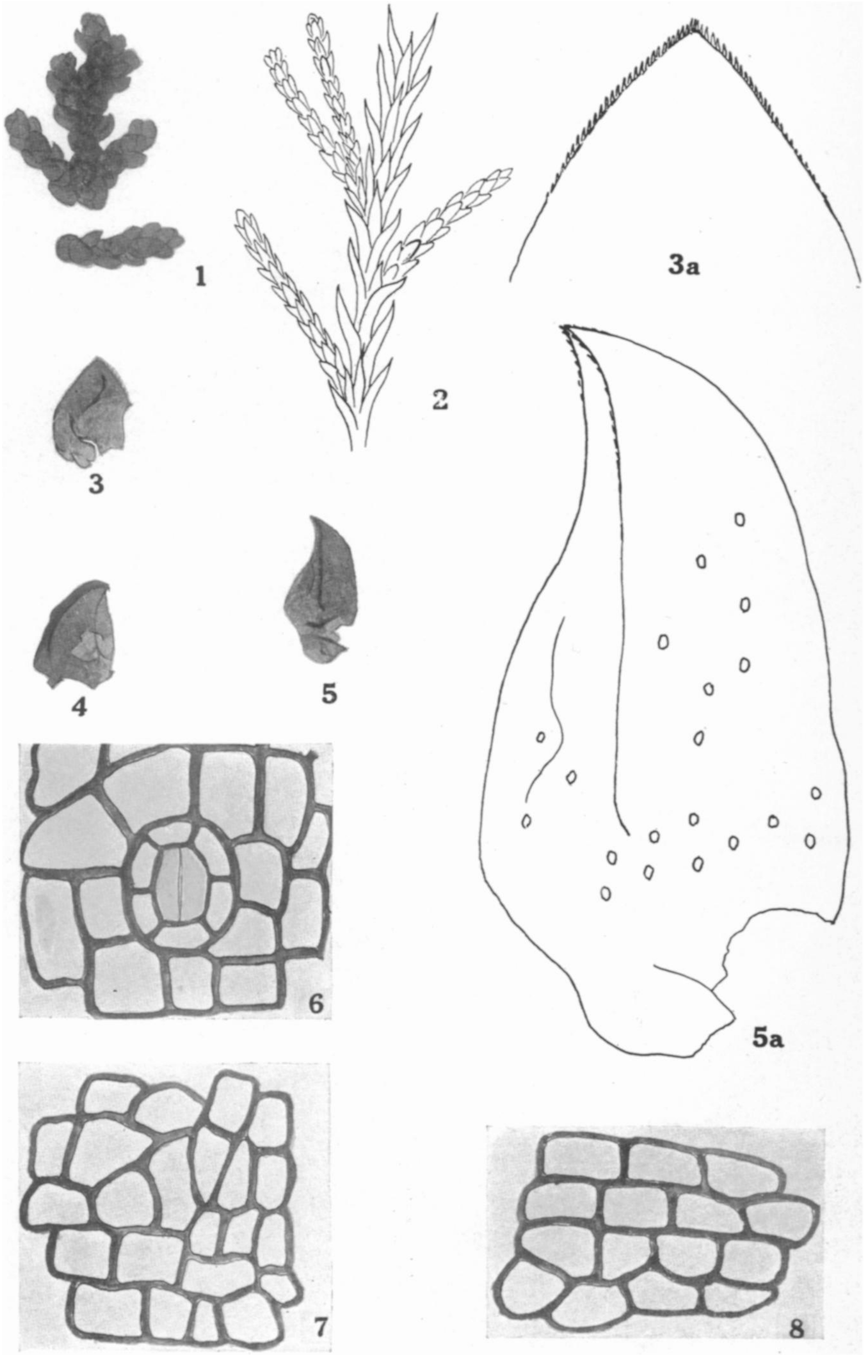
FIG. 5*a*. Drawing in outline of the specimen shown in FIG. 5, to show the location of the stomata, enlarged 50 times.

FIG. 6. Drawing of one of the stomata and the adjacent epidermal cells, enlarged 205 times.

FIG. 7, 8. Drawing to show the character of the epidermal cells, enlarged 205 times.



BERRY: WIDDRINGTONITES



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